

**Manuscript version: Author's Accepted Manuscript**

The version presented in WRAP is the author's accepted manuscript and may differ from the published version or Version of Record.

**Persistent WRAP URL:**

<http://wrap.warwick.ac.uk/129861>

**How to cite:**

Please refer to published version for the most recent bibliographic citation information. If a published version is known of, the repository item page linked to above, will contain details on accessing it.

**Copyright and reuse:**

The Warwick Research Archive Portal (WRAP) makes this work by researchers of the University of Warwick available open access under the following conditions.

Copyright © and all moral rights to the version of the paper presented here belong to the individual author(s) and/or other copyright owners. To the extent reasonable and practicable the material made available in WRAP has been checked for eligibility before being made available.

Copies of full items can be used for personal research or study, educational, or not-for-profit purposes without prior permission or charge. Provided that the authors, title and full bibliographic details are credited, a hyperlink and/or URL is given for the original metadata page and the content is not changed in any way.

**Publisher's statement:**

Please refer to the repository item page, publisher's statement section, for further information.

For more information, please contact the WRAP Team at: [wrap@warwick.ac.uk](mailto:wrap@warwick.ac.uk).

1    **Title**

2    Engagement with *MyFitnessPal* in eating disorders: Qualitative insights from online forums

3

4    **Running title**

5    MYFITNESSPAL USE IN EATING DISORDERS

6

7    **Authorship and affiliations**

8    Duncan McCaig<sup>a\*</sup>, Mark T. Elliott<sup>a</sup>, Katarina Prnjak<sup>b</sup>, Lukasz Walasek<sup>c</sup> and Caroline Meyer<sup>a,d,e</sup>

9

10    \*Corresponding author: Duncan McCaig. *Email address:* duncan.c.mccaig@gmail.com. *Address:*  
11    WMG, University of Warwick, UK, CV4 7AL

12

13    <sup>a</sup>WMG, University of Warwick, Coventry, UK; <sup>b</sup>School of Medicine, Western Sydney University,  
14    Sydney, Australia; <sup>c</sup>Department of Psychology, University of Warwick, Coventry, UK; <sup>d</sup>Warwick  
15    Medical School, University of Warwick, Coventry, UK; <sup>e</sup>Coventry and Warwickshire NHS Partnership  
16    Trust, Coventry, UK

17

18

## Abstract

*Objective:* Using calorie-counting and fitness-tracking technologies is concerning in relation to eating disorders. While studies in this area typically assess one aspect of use (e.g., frequency), engagement with a device or application is more complex. Consequently, important relationships between use of these technologies and eating disorder symptomatology might remain undetected. The current study therefore used comments from online eating disorder-related forums to generate comprehensive qualitative insights into engagement with a popular calorie-counting and fitness-tracking application, *MyFitnessPal*. *Method:* First, we extracted every comment mentioning *MyFitnessPal* made on three eating disorder-related forums between May 2015 and January 2018 (1695 comments from 920 commenters). Then, we conducted an inductive thematic analysis using these comments to identify important aspects of engagement with *MyFitnessPal*. *Results:* The analyses resulted in three themes: *Preventing misuse*, describing ways in which *MyFitnessPal* attempts to prevent pathological use, and actions taken by users to circumvent its interventions; *Accuracy*, outlining distrust of *MyFitnessPal*'s accuracy, and ways in which perceived inaccuracy is reduced or compensated for; and *Psychosocial factors*, comprising cognitive, behavioural and social factors that influence, or are influenced by, engagement with *MyFitnessPal*. *Discussion:* The qualitative insights provide a detailed overview of how people with high levels of eating disorder symptomatology likely engage with *MyFitnessPal*. The insights can be used as a basis to develop valid, quantitative assessment of pathological patterns of engagement with calorie-counting and fitness-tracking technology. The findings can also provide clinicians with insight into how their patients likely engage with, and are affected by, these devices and applications.

**Keywords:** eating disorders, self-monitoring, MyFitnessPal, social media, Reddit

## 1 Introduction

2           The ubiquity of commercially available calorie-counting and fitness-tracking technologies is a  
 3 cause for concern regarding eating disorders, as more patients with eating disorders view these  
 4 technologies as contributing to the maintenance of their condition than to their recovery (Tan, Kuek,  
 5 Goh, Lee, & Kwok, 2016). Accordingly, these devices and applications have been the focus of recent  
 6 research, which has been predominantly cross-sectional in nature. While results vary, these studies  
 7 generally suggest that use of these technologies – particularly fitness-trackers – is positively  
 8 associated with eating disorder-related symptomatology (Embacher Martin, McGloin, & Atkin, 2018;  
 9 Hefner et al., 2016; Plateau, Bone, Lanning, & Meyer, 2018; Simpson & Mazzeo, 2017).

10           A complicating factor for research concerning calorie-counting and fitness-tracking  
 11 technologies is that they vary in their functionality, such as providing different information (e.g.,  
 12 calorie-intake, steps), or influencing behaviour in different ways (e.g., facilitating self-monitoring,  
 13 rewarding behaviour; e.g., Lyons, Lewis, Mayrsohn, & Rowland, 2014). Reducing this complexity,  
 14 three studies have focused on the use of one application, *MyFitnessPal*, in relation to eating  
 15 psychopathology (Jospe et al., 2018; Levinson, Fewell, & Brosos, 2017; Linardon & Messer, 2019). The  
 16 main functions of *MyFitnessPal* enable users to set goals concerning weight, and calorie- and  
 17 macronutrient-intake, and assess their goal progress by: 1) estimating and tracking their calorie- and  
 18 nutrient-intake (e.g., consulting a food database, scanning barcodes, creating their own entries for  
 19 foods); 2) estimating and tracking calorie-expenditure (e.g., logging exercises, tracking steps); and 3)  
 20 recording their weight with optional photos of their body (Under Armour Inc., 2019). In two cross-  
 21 sectional studies focusing on *MyFitnessPal*, 73% (57/78) of predominantly female patients with  
 22 eating disorders who had used the application viewed it as, at a minimum, having somewhat  
 23 contributed to their condition (Levinson et al., 2017). A smaller proportion (47%, 26/55) of male users

recruited from health and fitness websites described it as, at least, somewhat contributing to disordered eating (Linardon & Messer, 2019). However, in contrast to these cross-sectional studies, an experimental study found no evidence for a causal effect of using *MyFitnessPal* on eating disorder symptomatology (Jospe et al., 2018; Jospe et al., 2017). Given the inconsistent results, it is important to explore factors that could influence the nature of these relationships.

One factor that could explain conflicting findings is that engagement with the same calorie-counting and fitness-tracking technology can vary between users. Engagement is a complex construct, comprising several aspects of how devices or applications are used (e.g., attention, duration, frequency), which are influenced by other factors (e.g., demographics, motivations; cf. Perski, Blandford, West, & Michie, 2016). However, in relation to eating psychopathology, the previously outlined research has assessed a narrow conceptualisation of engagement. Specifically, the self-report studies either assessed use dichotomously (i.e., user vs. non-user; Embacher Martin et al., 2018; Levinson et al., 2017; Linardon & Messer, 2019; Simpson & Mazzeo, 2017; Tan et al., 2016), or assessed the frequency of use (Hefner et al., 2016; Plateau et al., 2018). The risk of such narrow assessment of engagement is that patterns of use that are particularly indicative of eating disorders might remain undetected. Similarly, while no causal effect of *MyFitnessPal* use on eating disorder symptomatology was detected in the experimental study (Jospe et al., 2018), this finding could be due to the duration (or consistency) of engagement being insufficiently manipulated. Specifically, the participants in the '*MyFitnessPal*' condition used the application daily for the first month, but for only one week of each remaining month in the 12-month period (approximately 15 weeks in total; Jospe et al., 2017). As a result, the conclusions of existing research into calorie-counting and fitness-tracking technology cannot eliminate the possibility that null findings simply reflect that important pathological aspects of engagement have not been assessed or manipulated.

1 Therefore, a consideration of broader aspects of engagement with these devices and applications is  
2 vital.

3 Qualitative research is particularly valuable to understand the breadth of the engagement  
4 construct, and should ideally reflect ‘how participants think about the focal construct in their own  
5 words’ (p382; Gehlbach & Brinkworth, 2011). If such research identifies potentially pathological  
6 attributes of engagement in relation to eating psychopathology, the qualitative insights could be used  
7 to facilitate more precise research questions and develop more rigorous interventions. For example,  
8 if frequency of engagement were supported as being important, future experimental studies should  
9 assess this attribute (e.g., developing an application that records when it is used), and include it in  
10 their statistical analyses (e.g., as a covariate). Given the issues with self-report items used in previous  
11 research, the qualitative insights could also be used to develop a standardised scale of engagement  
12 with calorie-counting and fitness-tracking technologies in relation to eating disorders. Specifically,  
13 the insights could be used to develop an initial set of items (and response scales) that represent a  
14 sufficiently broad range of engagement attributes, have a high level of substantive validity evidence,  
15 and could then be subjected to structural and external validity testing (cf. Flake, Pek, & Hehman,  
16 2017).

17 Two studies offer a degree of substantive evidence for engagement with calorie-counting and  
18 fitness-tracking technologies in relation to eating disorders (Eikey & Reddy, 2017; Eikey et al., 2017).  
19 Both studies developed qualitative insights from 13 users who posted comments including eating  
20 disorder-related terms (e.g., ‘anorexia’) on an unspecified weight-loss application’s forum (Eikey et  
21 al., 2017), and from 16 young women who self-reported eating disorder symptoms (Eikey & Reddy,  
22 2017). The insights from both studies mainly identified cognitions and emotions (e.g., obsessiveness,  
23 perfectionism, guilt), and behaviours (e.g., restricting, binge eating, purging) related to use of these

technologies. In contrast, the studies identified fewer insights into patterns of engagement, except for use multiple times a day, and selectively not reporting information (e.g., exercise, calorie-intake exceeding a goal). While Eikey and colleagues' studies offer valuable insights into use of calorie-counting and fitness-tracking technologies, the small sample sizes might have limited their ability to capture the full range of patterns of use.

The aim of our current study was therefore to generate more comprehensive substantive evidence (i.e., qualitative insights) for the patterns of engagement with *MyFitnessPal*, as discussed by a large sample of commenters on online eating disorder-related forums. *MyFitnessPal* represented a particularly important calorie-counting and fitness-tracking technology to consider, as, of these types of technology, it has been found to be the most downloaded (Ferrara, Kim, Lin, Hua, & Seto, 2019) and the most commonly discussed in eating disorder-related online forums (McCaig, Bhatia, Elliott, Walasek, & Meyer, 2018), and is the focus of three previously discussed studies in the area of eating psychopathology (Jospe et al., 2018; Levinson et al., 2017; Linardon & Messer, 2019). Furthermore, as *MyFitnessPal* facilitates *both* calorie-counting *and* fitness-tracking, it is more representative of the varied functionality of these technologies than devices or applications dedicated to only one of these functions.

To achieve our aim, we extended our previous study that quantitatively assessed the mentions of fitness-tracking technology across three eating disorder-related forums on *Reddit* (McCaig et al., 2018), and we qualitatively analysed comments from these forums that mentioned *MyFitnessPal*. *Reddit* is one of the largest online discussion platforms, and several researchers have used data from the platform to investigate eating disorder-related topics (McCaig, Elliott, Siew, Walasek, & Meyer, 2019; Moessner, Feldhege, Wolf, & Bauer, 2018; Sowles et al., 2018). In line with Gehlbach and Brinkworth's recommendations (2011), content from social media is particularly

beneficial for developing substantive evidence, as it is uninfluenced by researchers, and so the focal construct is undoubtedly represented in the commenters' own words. Our approach also expands on Eikey and colleagues' previous study (2017) in three main ways. First, our approach ensures the relevance of the content to eating disorders by extracting comments from well-studied eating disorder-related forums, rather than a weight-loss application's forum. Second, our study provides more comprehensive substantive evidence by greatly increasing the sample size, established through scoping the data for relevant content in previous work (McCaig et al., 2018). Third, we focused on *MyFitnessPal*, which, as discussed, is important to consider for several reasons (i.e., popularity, focus of previous studies, supporting a wide range of functionality).

## Methods

### *Corpus selection*

The current study represents an extension of a previous study (McCaig et al., 2018). As such, we used the previously written Python code (Python Software Foundation, 2017) to extract public comments posted on *Reddit* between May 2015 to January 2018 (inclusive) from a freely available archive (Complete Public Reddit Comments Corpus, 2018). In contrast to the previous study, we restricted the current data corpus to comments made on the three eating disorder-related forums (*r/proED*, *r/fuckeatingdisorders*, *r/EatingDisorders*), and only extracted comments that included an explicit reference to *MyFitnessPal*, which constituted the use of at least one of the following terms: 'mfp', 'fitness pal', or 'fitnesspal'. Our institutional research ethics committee granted approval for the current study.

### *Data analysis*



We thematically analysed our data corpus, using Braun and Clarke's (2006) six-step guide as a reference. In brief, after reading through the comments to become familiar with the data (step 1), we developed an initial set of codes that each represented a meaningful aspect of the data (e.g., a pattern of engagement, an emotional consequence; step 2). The qualitative software *NVivo* (QSR International Pty Ltd., 2018) was used to facilitate this initial coding. We then grouped codes that were similar in meaning (step 3), and subsequently revised these groups (step 4), to create the themes and subthemes. Finally, we labelled and defined the themes and subthemes (step 5), and formalised the analysis in the production of this report (step 6). We used an inductive approach to the thematic analysis due to the exploratory nature of the research, and adopted a realist perspective focusing on themes at the semantic level – i.e., we were interested in the commenters' experiences, and focused on themes that were explicit within their comments.

Throughout all steps in the thematic analysis, the first author (DM) conducted the analyses, and the remaining authors acted as 'critical friends' (e.g., Smith & McGannon, 2017; Smith & Sparkes, 2006). In this role, the remaining authors challenged and offered alternatives to the first author's coding and interpretations, which facilitated reflexivity in the analysis, and ensured that the final thematic structure was rigorous and coherent. In line with current ethical guidance for internet-based research (cf. British Psychological Society, 2013; Williams, Nielsen, & Coulson, 2018), quotations provided in this report have been paraphrased to prevent identification of individual commenters, and are brief and used sparingly.

## Results

### *Corpus characteristics*

In total, 1695 comments including at least one reference to *MyFitnessPal* were made on the three eating disorder-related forums between May 2015 and January 2018, inclusive. These

comments were made by 920 commenters, who made on average (mean) 2 comments each that mentioned *MyFitnessPal* ( $SD=2$ , median=1, minimum=1, maximum=27). Overall, the corpus consisted of 157,278 words, and the average (mean) length of a comment was 93 words ( $SD=105$ , median=59, minimum=1, maximum=1281).

## Themes

Overall, we identified three themes: *Preventing misuse*, *Accuracy*, and *Psychosocial factors*. Each theme comprises subthemes, which we summarise in Table 1.

[insert Table 1 here]

### *Preventing misuse*

The theme *Preventing misuse* comprises two subthemes: *Interventions* and *Circumventing interventions*. *Interventions* describes measures that *MyFitnessPal* have ostensibly implemented to intervene if its users demonstrate symptoms associated with eating disorders. Commenters indicated experiencing the measures if they: recorded a daily calorie-intake below a minimum (with 1000kcal, 1200kcal, or a male-specific amount of 1500kcal being reported); were underweight; had an underweight or extreme weight-loss goal; were known or reported to have an eating disorder; or contributed content that encourages eating disorders to *MyFitnessPal* (e.g., creating a ‘pro-eating disorder’ forum). The nature of the interventions were indicated to vary, including notifications that users had recorded low daily calorie- or nutrient-intake, or that their weight was too low. Interventions restricting use included: not recording a day’s data; not providing a weight-loss prediction; and banning users, suspending or deleting their account, and directing them to an eating disorders ‘crisis’ website. Despite violating some of the limits (e.g., daily calorie-intake under 1000kcal), other commenters reported not experiencing any of the interventions, which was

suggested to be due to using an older or less common version of the application (e.g., on a ‘tablet’ device).

Perhaps reflecting negative views of the interventions (e.g., ‘punitive’, ‘judgemental’, ‘abusive’), commenters discussed how they could circumvent these measures (*Circumventing interventions* subtheme). Commenters reported altering specific characteristics, with men entering that they are women to have a lower minimum daily energy-intake, and others altering their height to enable a lower actual weight or weight-loss goal. On a more daily basis, the commenters indicated being able to record their actual energy-intake if they did not formally ‘complete the day’. Alternatively, commenters recorded extra energy-intake to meet the minimum, with some labelling the additional calories as fake (e.g., ‘padding’, ‘false’, ‘ghost calories’), and others keeping a physical record of their actual energy-intake to compare to their *MyFitnessPal* data (e.g., in a ‘notebook’). Commenters also described offsetting or correcting the additional energy-intake by adding an equivalent amount of energy-expenditure (e.g., exercise) or adding the extra energy-intake, then completing the day before deleting the extra calories. Regarding the notifications, some commenters mentioned ignoring these or disabling ‘pop-up messages’, while one commenter changed their device’s colours to greyscale so that the notifications were less salient. Others did not use *MyFitnessPal*’s associated forums, so that they were not discovered or reported to have an eating disorder. Last, many commenters simply stated that they used a different application or device that did not have the same interventions.

## *Accuracy*

The theme *Accuracy* comprises three subthemes: *Inaccuracy*, *Improving accuracy* and *Deliberate misrecording*. *Inaccuracy* details commenters’ distrust in the accuracy of *MyFitnessPal*. While some commenters expressed distrust generally, others did not trust certain functionality.

Specifically, calorie-content estimates of food and drink were seen to be inaccurate, with suggestions that: *MyFitnessPal* underestimates the calorie-content; there are discrepancies in estimates for the same item; and food and drink packaging does not match the entries in *MyFitnessPal*. The main reason for this distrust was seemingly due to the fact that anyone can create an entry for an item of food or drink in *MyFitnessPal*'s public database. Other functionality described as inaccurate were energy-expenditure estimates, which were viewed as overestimates and unreliable over time, and weight-loss or weight-maintenance predictions.

Several ways of improving *MyFitnessPal*'s accuracy were described, represented by the *Improving accuracy* subtheme. Regarding energy-intake, commenters ensured calorie-content estimates were as accurate as possible by comparing estimates to more trustworthy sources of information (e.g., packaging, governmental agencies), always creating their own estimates, and avoiding unverified entries in *MyFitnessPal*'s database. Some commenters also mentioned using a food scale to ensure the quantities of food or drink they entered were accurate. Similarly, the energy-expenditure estimates were reportedly improved by syncing *MyFitnessPal* with a more accurate device. Some commenters also described reviewing weekly or average data, as they saw this information as more accurate than daily results (i.e., minimising the impact of days that were outliers).

*Deliberate misrecording* describes strategies the commenters reported using to account for inaccuracy in *MyFitnessPal*, or their own perceived transgressions (e.g., overeating, underexercising). Such strategies included deliberately overestimating their energy-intake or weight, or underestimating their energy-expenditure. Concerning overestimating energy-intake, commenters detailed recording the meal they were going to eat, but then deliberately not eating all of it. Some stated that, if they exceeded their daily energy-intake, they added the excess to the following day.

However, others reported not recording excess energy-intake or episodes of binge eating, or entering a set amount of energy-intake for a binge eating episode rather than tracking it accurately. Additionally, commenters described underestimating or not recording energy-expenditure or purges, viewing any calories expended through these behaviours as a 'plus'.

### *Psychosocial factors*

The theme *Psychosocial factors* comprises three subthemes: *Cognition and affect*, *Behaviour*, and *Interpersonal factors*. *Cognition and affect* describes thoughts and feelings that influence, or are influenced by, the use of *MyFitnessPal*. Commenters indicated that recording energy-expenditure or deleting energy-intake (e.g., if planned calorie-intake was not consumed) improved their mood, and described more positive experiences the better their progress was regarding their goals (e.g., 'satisfied', 'in control', 'reassured'). Some commenters also indicated that they felt satisfied when they received a notification that their energy-intake was too low. Planning energy-intake or prerecording calorie-content before consumption was described as making the commenters feel more relaxed, and able to stop thinking about food or drink. Using *MyFitnessPal* also reportedly helped alleviate negative experiences (e.g., 'stressed', 'anxious'), particularly when estimates were perceived as accurate. However, some commenters reported not using *MyFitnessPal* to avoid negative feelings associated with its use (e.g., 'stress', 'worried', 'guilt'), which they described experiencing when they violated their goal by as little as one calorie, or even when they achieved their goal. Others also felt judged by *MyFitnessPal*'s standard functionality, such as notifications of consuming too much of a specific nutrient (e.g., fat). *MyFitnessPal* was reported to result in a greater awareness of the nutrient- or calorie-content of food and drink, with commenters explaining that they used it when starting a diet to learn about nutrient and calorie content or requirements, or that they stopped using it when they knew this information. The application was also seen to aid

motivation, such as feeling ‘accountable’ to something, but it was also suggested to increase competitiveness with oneself and others. Several commenters, including some who indicated being in recovery from eating disorders, reported feeling addicted to *MyFitnessPal*, and felt it contributed to overthinking about calories and food, and ruminating on binge eating episodes.

The *Behaviour* subtheme represents behaviours that are influenced by the use of *MyFitnessPal*, and related outcomes. The application was indicated to assist in restricting energy-intake, preventing overeating and binge eating, and interrupting the binge eating-purge cycle. Similarly, non-use was mentioned by some to trigger overeating. The assistance in restricting energy-intake reportedly resulted from *MyFitnessPal* helping them not to eat without thinking about calorie or nutritional content, with the habit of prerecording food or drink in the application (i.e., calculating its content before ingestion) indicated to be particularly helpful. Resulting from *MyFitnessPal*’s effect on behaviour, some commenters suggested that it facilitated a reduction in body size, shape and weight. However, others reported that the application did not assist restriction, and triggered purging, and overeating or binge eating, particularly when they had remaining calorie-intake for a day (i.e., calorie-intake was below their allowance). Due to *MyFitnessPal*’s influence on eating disorder-related behaviours, commenters mentioned avoiding or deleting *MyFitnessPal* in recovery, and expressed that its use facilitated relapse.

The subtheme *Interpersonal factors* represents social factors associated with using *MyFitnessPal*. Using its social functionality, commenters reported adding other people on the application, meaning others could view their data. While commenters mentioned adding friends and family, they also shared their usernames in the *Reddit* eating disorder-related forums, so they could connect with members of these online communities on *MyFitnessPal*. While *MyFitnessPal*’s own forums were mentioned, they were described as being a platform for people to criticise others for

their performance or lack of self-control. In contrast to being open about their use of *MyFitnessPal*, some commenters made their diary private to stop others from viewing their data, and, more generally, described concealing their habits of using the application from their friends and family (e.g., pretending to use a different application).

## Discussion

Our study aimed to provide comprehensive qualitative insights into engagement with a popular calorie-counting and fitness-tracking application, *MyFitnessPal*, as described by commenters on online eating disorder-related forums. By thematically analysing a large sample of 1695 comments from eating disorder-related forums that mentioned *MyFitnessPal*, contributed by 920 commenters, we generated three themes – *Preventing misuse*, *Accuracy*, and *Psychosocial factors*. In addition to identifying patterns of engagement with calorie-counting and fitness-tracking technology, the themes also expand on previous findings of psychosocial factors that influence and result from using these devices and applications.

Within *Preventing misuse*, we describe several interventions ostensibly implemented by *MyFitnessPal* to address pathological use, and ways in which commenters reported circumventing its interventions. While Levinson and colleagues (2017) mentioned notifications of low calorie-intake, *MyFitnessPal* also reportedly intervenes in other ways if a user is suspected of having an eating disorder. For example, the application appears to limit its functionality in such users (e.g., preventing the recording of data, not providing weight-loss predictions), or ban them and delete their accounts. However, the interventions appear to be inconsistently applied, or are easy to circumvent, such as by simply using a different application or device. The use of alternative technology parallels findings concerning pro-eating disorder content, which indicated that banned ‘hashtags’ (i.e., ways of flagging content to other interested users) were simply replaced with new ones (Gerrard, 2018). While a

change in policy could mandate the inclusion of interventions in commercially available calorie-counting and fitness-tracking technology, this approach would likely be ineffective as older versions would still be available, or motivated users could create their own. As such, there is a need for researchers and companies to take shared responsibility for developing and implementing more effective interventions in these technologies. To prevent users from disengaging and using a different application or device, interventions could potentially be more effective if they are subtle, so that they are not viewed as 'punitive', 'judgemental', or 'abusive'. Such interventions could involve the provision of psychoeducation to current users (cf. Levinson et al., 2017), as, currently, *MyFitnessPal* only appears to provide this information to users whom it bans.

The *Accuracy* theme describes a reported distrust in the accuracy of various aspects of *MyFitnessPal's* functionality, and several ways in which the commenters reported reducing this inaccuracy. Of concern, the commenters also reported deliberately misrecording their data to create 'room for error'. Supporting previous findings (Eikey & Reddy, 2017), the commenters in our study indicated underestimating their energy-expenditure, or not recording this information or purges, instead viewing any calories expended as a bonus. We also found that commenters reported overestimating their energy-intake, using heuristics (e.g., a set calorie-content for a binge eating episode), or pre-recording energy-intake but planning not to consume it. Taken together, the findings suggest a degree of self-deception in how users engage with *MyFitnessPal*, with deliberate misrecording seemingly in a direction that facilitates weight-loss (i.e., overestimating energy-intake, underestimating energy-expenditure). Due to the potential self-deception, improving the accuracy of calorie-counting and fitness-tracking technologies might have a minimal effect on these behaviours. Tentative evidence supports improved accuracy having little effect, as, compared to people with low dietary restraint, the energy-intake of more highly restrained people is less influenced in the short-term by energy-expenditure feedback (McCaig, Hawkins, & Rogers, 2016).



Last, we identified psychosocial factors that reportedly influence, or are influenced by, engagement with *MyFitnessPal*. As with previous findings (Eikey & Reddy, 2017; Eikey et al., 2017), there was variability in whether commenters viewed engagement as facilitating or worsening psychosocial factors, such as negative feelings (e.g., 'stress'), and eating disorder-related behaviours and outcomes (e.g., restricting, weight-loss). Such heterogeneity suggests moderators in the relationship between engagement with calorie-counting and fitness-tracking technologies, and eating disorder-related symptomatology, which could explain the inconsistencies in previous research (Embacher Martin et al., 2018; Hefner et al., 2016; Plateau et al., 2018; Simpson & Mazzeo, 2017). A user's motivational stage of change regarding eating disorder recovery (cf. Geller, Cockell, & Drab, 2001) is likely a key moderator in this relationship, as the current and previous findings (Eikey & Reddy, 2017) suggest that people in recovery alter their use of calorie-counting and fitness-tracking technologies (e.g., deleting the application). Our findings also emphasise the likely importance of perfectionistic, dichotomous and obsessive thinking styles in this context, as suggested by previous researchers (e.g., experience anxiety if exceed goal by one calorie; Eikey & Reddy, 2017; Levinson et al., 2017; Linardon & Messer, 2019; Simpson & Mazzeo, 2017). Last, in addition to supporting findings that users viewed *MyFitnessPal* as increasing competitiveness with oneself (Eikey & Reddy, 2017), commenters in our study also viewed it as increasing their competitiveness with others. Together with our observation that people exchanged their *MyFitnessPal* usernames on the *Reddit* forums, the higher competitiveness with others could facilitate members of pro-eating disorder online communities encouraging each other's pathological behaviours.

Regarding the limitations of our study, it is not possible to characterise the commenters on eating disorder-related forums in terms of their type or degree of eating disorder symptomatology. Consequently, future research is required to investigate whether varying diagnoses and levels of eating pathology are related to different patterns of engagement with *MyFitnessPal*. A limitation of

our data extraction method is that it is possible that we did not identify relevant content that referred to *MyFitnessPal* with a pronoun (e.g., 'it') rather than one of our search terms ('mfp', 'fitness pal', 'fitnesspal'). However, the effect of this limitation is mitigated by the large sample size. Last, our study focused on *MyFitnessPal* and, consequently, the conclusions cannot be applied uncritically to similar devices and applications. However, due to *MyFitnessPal* supporting both calorie-counting and fitness-tracking, we consider it likely that our findings would also apply to technologies with the same functionalities.

The qualitative insights obtained in the current study have several implications for future research. First, the findings can be used in the development of a standardised measure of engagement with calorie-counting and fitness-tracking technology in relation to eating psychopathology. Specifically, the insights can guide the generation of a set of items, which can then be subjected to structural and external validity testing (cf. Flake et al., 2017). While previous self-report items assess a narrow conceptualisation of engagement (e.g., assessing use dichotomously; e.g., Simpson & Mazzeo, 2017), our findings outline other patterns of engagement that should be assessed (e.g., recording calories that are not actually consumed), and indicate ways in which existing self-report items might be improved. For example, we identified pre-recording calorie-containing items before consumption as a potentially important pattern of engagement in people with high levels of eating psychopathology. However, if such pre-recording is characteristic of someone who has, on average, few daily eating episodes (i.e., is restricting), this pattern of engagement could explain the previously observed lack of an association between the frequency of calorie-counter use and eating disorder symptomatology (Plateau et al., 2018). In contrast, such an association might be found if frequency of use were assessed differently – e.g., 'When you consume calories, how often do you use a calorie-counting application or device?' ('Never' to 'Every time' response options). Through developing a more valid, quantitative measure of engagement, the degree to which each

aspect of engagement is associated with eating disorder-related factors (e.g., symptoms, diagnoses, stage of recovery) could be assessed. If an aspect of engagement were identified as indicative of a factor (e.g., a specific symptom), intervention content could be tailored to the factor, and then targeted at users displaying the related pattern of use. More generally, future research should investigate the causal relationships between the aspects of engagement and psychosocial factors identified in the current study. For example, whether higher dietary restraint *leads to* overestimating energy intake, *is a result of* overestimating energy intake, or both.

Overall, through using an inductive (i.e., bottom-up') approach, our study found support for engagement with calorie-counting and fitness-tracking technology being a multifaceted construct. Future research in the area of eating disorders should therefore consider and assess the breadth of the construct. Additionally, our findings can provide clinicians with insight into how eating disorder patients might use (or have used) calorie-counting and fitness-tracking technology. Consequently, after asking whether or not patients have used such devices or applications, clinicians can pose questions that lead to potentially more informative responses (e.g., 'How accurately do you record your energy intake and expenditure?').

1 **Conflict of interest statement**

2 The authors declare no conflict of interest.

## 1    **References**

- 2    Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in*  
3        *Psychology*, 3(2), 77-101. doi:10.1191/1478088706qp063oa
- 4    British Psychological Society. (2013). *Ethics Guidelines for Internet-mediated Research*. Retrieved  
5        from Leicester: [www.bps.org.uk/publications/policy-andguidelines/research-guidelines-](http://www.bps.org.uk/publications/policy-andguidelines/research-guidelines-policydocuments/research-guidelines-poli)  
6        [policydocuments/research-guidelines-poli](http://www.bps.org.uk/publications/policy-andguidelines/research-guidelines-policydocuments/research-guidelines-poli)
- 7    Complete Public Reddit Comments Corpus. (2018). *Retrieved from*  
8        [https://archive.org/details/2015\\_reddit\\_comments\\_corpus](https://archive.org/details/2015_reddit_comments_corpus).
- 9    Eikey, E. V., & Reddy, M. C. (2017). *"It's Definitely Been a Journey": A Qualitative Study on How*  
10        *Women with Eating Disorders Use Weight Loss Apps*. Paper presented at the Proceedings of  
11        the 2017 CHI Conference on Human Factors in Computing Systems - CHI '17.
- 12    Eikey, E. V., Reddy, M. C., Booth, K. M., Kvasny, L., Blair, J. L., Li, V., & Poole, E. S. (2017). Desire to  
13        Be Underweight: Exploratory Study on a Weight Loss App Community and User Perceptions  
14        of the Impact on Disordered Eating Behaviors. *JMIR Mhealth Uhealth*, 5(10), e150.  
15        doi:10.2196/mhealth.6683
- 16    Embacher Martin, K., McGloin, R., & Atkin, D. (2018). Body dissatisfaction, neuroticism, and female  
17        sex as predictors of calorie-tracking app use amongst college students. *J Am Coll Health*, 1-9.  
18        doi:10.1080/07448481.2018.1431905
- 19    Ferrara, G., Kim, J., Lin, S., Hua, J., & Seto, E. (2019). A Focused Review of Smartphone Diet-Tracking  
20        Apps: Usability, Functionality, Coherence With Behavior Change Theory, and Comparative  
21        Validity of Nutrient Intake and Energy Estimates. *JMIR Mhealth Uhealth*, 7(5), e9232.  
22        doi:10.2196/mhealth.9232

- 1 Flake, J. K., Pek, J., & Hehman, E. (2017). Construct Validation in Social and Personality Research.  
2 *Social Psychological and Personality Science*, 8(4), 370-378. doi:10.1177/1948550617693063
- 3 Gehlbach, H., & Brinkworth, M. E. (2011). Measure Twice, Cut down Error: A Process for Enhancing  
4 the Validity of Survey Scales. *Review of General Psychology*, 15(4), 380-387.  
5 doi:10.1037/a0025704
- 6 Geller, J., Cockell, S. J., & Drab, D. L. (2001). Assessing readiness for change in the eating disorders:  
7 The psychometric properties of the readiness and motivation interview. *Psychological*  
8 *Assessment*, 13(2), 189-198. doi:10.1037//1040-3590.13.2.189
- 9 Gerrard, Y. (2018). Beyond the hashtag: Circumventing content moderation on social media. *New*  
10 *Media & Society*, 20(12), 4492-4511. doi:10.1177/1461444818776611
- 11 Hefner, V., Dorros, S. M., Jourdain, N., Liu, C., Tortomasi, A., Greene, M. P., . . . Alvares, C. (2016).  
12 Mobile exercising and tweeting the pounds away: The use of digital applications and  
13 microblogging and their association with disordered eating and compulsive exercise. *Cogent*  
14 *Social Sciences*, 2(1). doi:10.1080/23311886.2016.1176304
- 15 Jospe, M. R., Brown, R. C., Williams, S. M., Roy, M., Meredith-Jones, K. A., & Taylor, R. W. (2018).  
16 Self-monitoring has no adverse effect on disordered eating in adults seeking treatment for  
17 obesity. *Obes Sci Pract*, 4(3), 283-288. doi:10.1002/osp4.168
- 18 Jospe, M. R., Roy, M., Brown, R. C., Williams, S. M., Osborne, H. R., Meredith-Jones, K. A., . . . Taylor,  
19 R. W. (2017). The Effect of Different Types of Monitoring Strategies on Weight Loss: A  
20 Randomized Controlled Trial. *Obesity (Silver Spring)*, 25(9), 1490-1498.  
21 doi:10.1002/oby.21898

- 1    Levinson, C. A., Fewell, L., & Brosof, L. C. (2017). My Fitness Pal calorie tracker usage in the eating  
2        disorders. *Eat Behav*, 27, 14-16. doi:10.1016/j.eatbeh.2017.08.003
- 3    Linardon, J., & Messer, M. (2019). My fitness pal usage in men: Associations with eating disorder  
4        symptoms and psychosocial impairment. *Eat Behav*, 33, 13-17.  
5        doi:10.1016/j.eatbeh.2019.02.003
- 6    Lyons, E. J., Lewis, Z. H., Mayrsohn, B. G., & Rowland, J. L. (2014). Behavior change techniques  
7        implemented in electronic lifestyle activity monitors: a systematic content analysis. *J Med*  
8        *Internet Res*, 16(8), e192. doi:10.2196/jmir.3469
- 9    McCaig, D., Bhatia, S., Elliott, M. T., Walasek, L., & Meyer, C. (2018). Text-mining as a methodology  
10       to assess eating disorder-relevant factors: Comparing mentions of fitness tracking  
11       technology across online communities. *Int J Eat Disord*, 647-655. doi:10.1002/eat.22882
- 12   McCaig, D., Elliott, M. T., Siew, C. S. Q., Walasek, L., & Meyer, C. (2019). Profiling commenters on  
13       mental health-related online forums: A methodological example focusing on eating  
14       disorder-related commenters. *JMIR Mental Health*, 6(4), e12555. doi:10.2196/12555
- 15   McCaig, D., Hawkins, L., & Rogers, P. (2016). Licence to eat: Information on energy expended during  
16       exercise affects subsequent energy intake. *Appetite*, 107, 323-329.  
17       doi:10.1016/j.appet.2016.08.107
- 18   Moessner, M., Feldhege, J., Wolf, M., & Bauer, S. (2018). Analyzing big data in social media: Text  
19       and network analyses of an eating disorder forum. *Int J Eat Disord*, 656-667.  
20       doi:10.1002/eat.22878

- 1 Perski, O., Blandford, A., West, R., & Michie, S. (2016). Conceptualising engagement with digital  
2 behaviour change interventions: a systematic review using principles from critical  
3 interpretive synthesis. *Transl Behav Med.* doi:10.1007/s13142-016-0453-1
- 4 Plateau, C. R., Bone, S., Lanning, E., & Meyer, C. (2018). Monitoring eating and activity: Links with  
5 disordered eating, compulsive exercise, and general wellbeing among young adults. *Int J Eat*  
6 *Disord*, 51(11), 1270-1276. doi:10.1002/eat.22966
- 7 Python Software Foundation. (2017). Python Language Reference (Version 3.6.3.). Available at  
8 <http://www.python.org>.
- 9 QSR International Pty Ltd. (2018). NVivo qualitative data analysis software (Version 12).
- 10 Simpson, C. C., & Mazzeo, S. E. (2017). Calorie counting and fitness tracking technology:  
11 Associations with eating disorder symptomatology. *Eat Behav*, 26, 89-92.  
12 doi:10.1016/j.eatbeh.2017.02.002
- 13 Smith, B., & McGannon, K. R. (2017). Developing rigor in qualitative research: problems and  
14 opportunities within sport and exercise psychology. *International Review of Sport and*  
15 *Exercise Psychology*, 1-21. doi:10.1080/1750984x.2017.1317357
- 16 Smith, B., & Sparkes, A. C. (2006). Narrative inquiry in psychology: exploring the tensions within.  
17 *Qualitative Research in Psychology*, 3(3), 169-192. doi:10.1191/1478088706qrp068oa
- 18 Sowles, S. J., McLeary, M., Optican, A., Cahn, E., Krauss, M. J., Fitzsimmons-Craft, E. E., . . . Cavazos-  
19 Rehg, P. A. (2018). A content analysis of an online pro-eating disorder community on Reddit.  
20 *Body Image*, 24, 137-144. doi:10.1016/j.bodyim.2018.01.001



- 1 Tan, T. N., Kuek, A., Goh, S. E., Lee, E. L., & Kwok, V. (2016). Internet and smartphone application  
2 usage in eating disorders: A descriptive study in Singapore. *Asian Journal of Psychiatry*, 19,  
3 50-55. doi:10.1016/j.ajp.2015.11.007
- 4 Under Armour Inc. (2019). MyFitnessPal.com: Free Calorie Counter, Diet & Exercise Journal  
5 Retrieved from [https://www.myfitnesspal.com/welcome/learn\\_more](https://www.myfitnesspal.com/welcome/learn_more)
- 6 Williams, A. J., Nielsen, E., & Coulson, N. S. (2018). "They aren't all like that": Perceptions of clinical  
7 services, as told by self-harm online communities. *J Health Psychol*, 1359105318788403.  
8 doi:10.1177/1359105318788403

9

1 Table 1. A summary of the identified themes and subthemes

Theme	Subtheme	Description
Preventing misuse	Interventions	Interventions implemented by <i>MyFitnessPal</i> aimed at preventing use in people who pursue underweight goals, severely limit energy-intake, or endorse 'pro-eating disorder' ideals (i.e., encourage eating disorders)
	Circumventing interventions	Ways in which people change their engagement with <i>MyFitnessPal</i> in response to its interventions
Accuracy	Inaccuracy	Distrust in the accuracy of <i>MyFitnessPal</i>
	Improving accuracy	Ways in which people improve <i>MyFitnessPal's</i> accuracy
	Deliberate misrecording	Deliberate misrecording to allow room for error (e.g., <i>MyFitnessPal's</i> inaccuracy, perceived goal violations)
Psychosocial factors	Cognition and affect	Cognitions and affect that influence, or are influenced by, the use of <i>MyFitnessPal</i>
	Behaviour	Behaviours that are influenced by the use of <i>MyFitnessPal</i> , and their associated outcomes (e.g., weight)
	Interpersonal factors	Interpersonal factors associated with using <i>MyFitnessPal</i>

2